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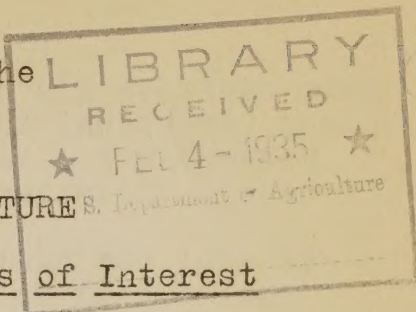
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ANIMAL HUSBANDRY DIVISION  
HAWAII AGRICULTURAL EXPERIMENT STATION  
HONOLULU, HAWAII

Under the joint supervision of the

UNIVERSITY OF HAWAII  
and the  
UNITED STATES DEPARTMENT OF AGRICULTURE

Progress Notes on Experiments and Other Items of Interest



No. 8

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These progress notes on experimental work and other items of interest to livestock men in the Territory are issued from time to time by the Animal Husbandry Division. You are invited to suggest other lines of research that you deem important and to submit inquiries to the University.

GREEN PANICUM GRASS VS. GREEN SUDAN  
GRASS FOR DAIRY COWS

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Introduction

Panicum grass<sup>2</sup>, also known as Para grass and in some sections as California grass, is widely scattered over Oahu and to a lesser extent over the other Islands of the Territory. It grows best in low wet places and covers many such areas as a volunteer growth. Pineapple plantations have used this grass as a rotation crop between cycles of pineapple crops. In recent years many dairymen having suitable land have planted Panicum grass in fields formerly planted to Sudan or some other grass. Other dairymen lacking land drive long distances to gulches where this grass grows, cut same with a grass sickle, and haul it to their dairies. As this grass is largely used to replace Sudan grass, it seemed that some experimental work on the relative value of these two roughages for dairy cattle seemed desirable.

Plan of Experiments

In these experiments the roughages were cut and fed to the cattle in feed racks in the two small pastures (36 x 200 feet) where the cattle were confined except during the milking hours. The roughages were weighed for each lot before being put in the feed racks and unconsumed roughages were weighed back. The cows in each lot were given as much of the respective roughages as they would consume.

<sup>1</sup>The valuable help of G.W.H. Goo, Assistant in Animal Husbandry, in computing the data of these experiments is acknowledged.

<sup>2</sup>Panicum barbinode.







Two experiments were conducted--the first with six Holstein cows for a nine-week period from March 30 to May 31, 1933 inclusive, the second with four Holstein and two Guernsey cows over a twelve-week period from September 28 to December 20, 1933 inclusive.

In each experiment the six cows were divided into two lots of three each. In dividing the cows breed, age, date of freshening, date due to calve, weight and production were considered and balanced as equally as possible between the two lots.

The double reversal system of feeding was followed. Lot A in each experiment was started on the Panicum grass and after three weeks (four weeks in the second experiment) was shifted to Sudan grass for roughage and again shifted back to Panicum grass for the last three- or four-week period of the nine- and twelve-week experiment respectively. Lot B in each experiment was started on Sudan grass and fed Panicum grass and Sudan grass respectively during the second and third periods of each experiment. In each experiment the first week of each period was used to accustom the cows to change of feed and only the last two and three weeks of each period of the respective experiments were used in computing results.

The mean of the first and last periods of each lot was compared with the second or middle period in order to compensate for decreasing production due to advancing lactation.

#### The Concentrate Feeds

Since both roughages used in these experiments are non-legumes and rather low in protein, a medium high protein concentrate mixture was fed to insure the cows getting ample protein. This mixture was as follows:

200 lbs.	soybean oil cake meal
480 "	wheat bran
300 "	rolled barley
12 "	raw rock phosphate
12 "	salt

This mixture supplied 16.6 percent digestible crude protein and 69.7 percent digestible total nutrients and cost \$24.20 per ton during the first experiment and \$28.60 during the second test.

Each cow in each experiment was fed two pounds of beet pulp daily in addition to the other concentrates and roughages.

The amount of concentrates given to each cow depended on her production so that during the first and second period of the experiment the cows received amounts that were adjusted with their production. But during the last period, the amounts of grain given were based on the amounts given during the first and second periods so that the average of the first and last period would equal the middle period.



The experimental units were established with six Holstein cows in a nine-week period from March 20 to May 21, 1953 inclusive. The second six cows were established in a nine-week period from September 22 to November 20, 1953 inclusive.

In each experiment the six cows were divided into two lots of three each. In dividing the cows treated, care was taken to obtain lots as to age, weight and condition were considered and balanced as equally as possible between the two lots.

The double crossover system of feeding was followed. Lot A in each experiment was started on the 1st ration and after three weeks (one week in the second experiment) was shifted to Ration B. Lot B was shifted back to Ration A after the last three weeks of the nine- and twelve-week experiments respectively. Lot B in each experiment was started on Ration A and after three weeks was shifted to Ration B. The periods and feeding periods of each experiment. In each experiment the first week of each period was used to determine the cows to change of feed and only the last two and three weeks of each period of the respective experiments were used in making results.

The mean of the first and last periods of each lot was compared with the second or middle period in order to compare the experimental units to determine lactation.

### The Concentrate Feeds

Since both rations used in these experiments are non-lactating and contain no protein, a medium grain protein concentrate mixture was fed to insure the cows getting ample protein. This mixture was as follows:

800 lbs.	soybean oil cake meal
400 "	wheat bran
300 "	rolled barley
10 "	raw rock phosphate
10 "	salt

This mixture supplied 16.5 percent digestible crude protein and 69.7 percent digestible total nutrients and cost \$24.30 per ton during the first experiment and \$28.60 during the second test.

Each cow in each experiment was fed two pounds of feed plus daily in addition to the other concentrates and roughage.

The amount of concentrates given to each cow depended on her production so that during the first and second period of the experiment the cows received amounts that were adjusted with their production. But during the last period, the amounts of grain given were based on the amounts given during the first and second periods so that the average of the first and last period would equal the middle period.

Thus a cow that was fed 12 pounds and 11 pounds daily during the first and second periods was given 10 pounds during the last period. To have varied the concentrates would have introduced a quantity variable in the amount of grain fed--something we wished to avoid when comparing the value of different roughages.

### Cows Used and Feeding Schedules

#### Experiment I

The cows in the first experiment were much further along in their lactation than was desirable with consequent low production, but since these were the only cows available at the time, it seemed best to use them for the first test for whatever information could be secured rather than delay the starting of the experiments.

	Cow No.	'Breed'	Age	'Days since'		'Daily production 'on March 7, 10, 19
				'calving to'	'Due to calve'	
				3/30/33		Lbs.
<u>Lot A</u>						
	88	H	5½	369	8/24/33	24.2
	109	H	4	241	10/26/33	19.5
	113	H	3	222	---	19.8
<u>Average</u>			4	277		21.2
<u>Lot B</u>						
	104	H	4	205	10/12/33	22.4
	105	H	4	190	10/12/33	21.5
	111	H	3	244	9/3/33	19.1
<u>Average</u>			4	213		21.0

#### Feeding Schedule

Cow Number	Lot A			Lot B		
	88	109	113	104	105	111
Inclusive days						
1933						
Mar. 30 - Apr. 19	P	P	P	S	S	S
Apr. 20 - May 10	S	S	S	P	P	P
May 11 - May 31	P	P	P	S	S	S
June 1 -	Returned to roughage fed previous to March 30, 1933.					

P - Panicum grass

S = Sudan grass







# Experiment II

			'Days since'			'Average production'
Cow			'calving to'	Due to	'September 12, 17, 24	
No.	'Breed'	Age	'9-28-33'	'calve'	'lbs. milk'	
<u>Lot A</u>						
52	H	10	183	--		32.1
71	H	7 $\frac{1}{2}$	147	5-8-34		28.0
96	G	5 $\frac{1}{2}$	80	--		24.1
Average		8	137			28.1
<u>Lot B</u>						
74	H	7	243	4-29-34		28.3
79	H	6 $\frac{1}{2}$	169	5-9-34		28.3
89	G	6	143	5-2-34		25.9
Average		6 $\frac{1}{2}$	188			27.8

H = Holstein

G = Guernsey

## Feeding Schedule

Cow Number	Lot A			Lot B		
	52	71	96	74	79	89
Inclusive days						
1933						
Sept. 28 - Oct. 25	P	P	P	S	S	S
Oct. 26 - Nov. 22	S	S	S	P	P	P
Nov. 23 - Dec. 20	P	P	P	S	S	S
Dec. 21 -	Returned to roughage fed previous to Sept. 28, 1933.					

P = Panicum grass

S = Sudan grass

## Body Weights of Cows

All the cows in both experiments were weighed once each week on the same afternoon at about the same hour. The average weights for the different cows on the different roughages as well as the averages for the lots on the entire experiment for each roughage follow:

# Experiment II

Cow				
1935	1936	1937	1938	1939
10	10	10	10	10
11	11	11	11	11
12	12	12	12	12
13	13	13	13	13
14	14	14	14	14
15	15	15	15	15
16	16	16	16	16
17	17	17	17	17
18	18	18	18	18
19	19	19	19	19
20	20	20	20	20
21	21	21	21	21
22	22	22	22	22
23	23	23	23	23
24	24	24	24	24
25	25	25	25	25
26	26	26	26	26
27	27	27	27	27
28	28	28	28	28
29	29	29	29	29
30	30	30	30	30
31	31	31	31	31
32	32	32	32	32
33	33	33	33	33
34	34	34	34	34
35	35	35	35	35
36	36	36	36	36
37	37	37	37	37
38	38	38	38	38
39	39	39	39	39
40	40	40	40	40
41	41	41	41	41
42	42	42	42	42
43	43	43	43	43
44	44	44	44	44
45	45	45	45	45
46	46	46	46	46
47	47	47	47	47
48	48	48	48	48
49	49	49	49	49
50	50	50	50	50
51	51	51	51	51
52	52	52	52	52
53	53	53	53	53
54	54	54	54	54
55	55	55	55	55
56	56	56	56	56
57	57	57	57	57
58	58	58	58	58
59	59	59	59	59
60	60	60	60	60
61	61	61	61	61
62	62	62	62	62
63	63	63	63	63
64	64	64	64	64
65	65	65	65	65
66	66	66	66	66
67	67	67	67	67
68	68	68	68	68
69	69	69	69	69
70	70	70	70	70
71	71	71	71	71
72	72	72	72	72
73	73	73	73	73
74	74	74	74	74
75	75	75	75	75
76	76	76	76	76
77	77	77	77	77
78	78	78	78	78
79	79	79	79	79
80	80	80	80	80
81	81	81	81	81
82	82	82	82	82
83	83	83	83	83
84	84	84	84	84
85	85	85	85	85
86	86	86	86	86
87	87	87	87	87
88	88	88	88	88
89	89	89	89	89
90	90	90	90	90
91	91	91	91	91
92	92	92	92	92
93	93	93	93	93
94	94	94	94	94
95	95	95	95	95
96	96	96	96	96
97	97	97	97	97
98	98	98	98	98
99	99	99	99	99
100	100	100	100	100

1935 1936 1937 1938 1939

## Feeding Schedule

Cow Number				
1935	1936	1937	1938	1939
10	10	10	10	10
11	11	11	11	11
12	12	12	12	12
13	13	13	13	13
14	14	14	14	14
15	15	15	15	15
16	16	16	16	16
17	17	17	17	17
18	18	18	18	18
19	19	19	19	19
20	20	20	20	20
21	21	21	21	21
22	22	22	22	22
23	23	23	23	23
24	24	24	24	24
25	25	25	25	25
26	26	26	26	26
27	27	27	27	27
28	28	28	28	28
29	29	29	29	29
30	30	30	30	30
31	31	31	31	31
32	32	32	32	32
33	33	33	33	33
34	34	34	34	34
35	35	35	35	35
36	36	36	36	36
37	37	37	37	37
38	38	38	38	38
39	39	39	39	39
40	40	40	40	40
41	41	41	41	41
42	42	42	42	42
43	43	43	43	43
44	44	44	44	44
45	45	45	45	45
46	46	46	46	46
47	47	47	47	47
48	48	48	48	48
49	49	49	49	49
50	50	50	50	50
51	51	51	51	51
52	52	52	52	52
53	53	53	53	53
54	54	54	54	54
55	55	55	55	55
56	56	56	56	56
57	57	57	57	57
58	58	58	58	58
59	59	59	59	59
60	60	60	60	60
61	61	61	61	61
62	62	62	62	62
63	63	63	63	63
64	64	64	64	64
65	65	65	65	65
66	66	66	66	66
67	67	67	67	67
68	68	68	68	68
69	69	69	69	69
70	70	70	70	70
71	71	71	71	71
72	72	72	72	72
73	73	73	73	73
74	74	74	74	74
75	75	75	75	75
76	76	76	76	76
77	77	77	77	77
78	78	78	78	78
79	79	79	79	79
80	80	80	80	80
81	81	81	81	81
82	82	82	82	82
83	83	83	83	83
84	84	84	84	84
85	85	85	85	85
86	86	86	86	86
87	87	87	87	87
88	88	88	88	88
89	89	89	89	89
90	90	90	90	90
91	91	91	91	91
92	92	92	92	92
93	93	93	93	93
94	94	94	94	94
95	95	95	95	95
96	96	96	96	96
97	97	97	97	97
98	98	98	98	98
99	99	99	99	99
100	100	100	100	100

1935 1936 1937 1938 1939

## Body Weights in Pounds

All the cows in both experiments were of the same breed and were of the same age. The average weight of the cows in the first experiment was 1,000 pounds and the average weight of the cows in the second experiment was 1,100 pounds. The difference in weight was due to the fact that the cows in the second experiment were heavier than the cows in the first experiment.



# Cattle Weights in Pounds

## Experiment I

Cow Number	Lot A			Lot B		
	88	109	113	104	105	111
Average weight on green Panicum grass	1240	920	893	965	1080	980
Average weight on green Sudan grass	1235	960	915	970	1075	988
Lot A - Average weight on green Panicum grass	--	1018	pounds			
Lot A - Average weight on green Sudan grass	--	1037	"			
Lot B - Average weight on green Panicum grass	--	1008	"			
Lot B - Average weight on green Sudan grass	--	1011	"			
Average weight, all cows on green Panicum grass	-	1013	"			
Average weight, all cows on green Sudan grass	-	1024	"			
Difference in weight in favor of Sudan grass	-	11	"			

## Experiment II

Cow Number	Lot A			Lot B		
	52	71	96	74	79	89
Average weight on green Panicum grass	896	978	950	1163	877	960
Average weight on green Sudan grass	893	983	947	1180	885	955
Lot A - Average weight on green Panicum grass	--	941	pounds			
Lot A - Average weight on green Sudan grass	--	941	"			
Lot B - Average weight on green Panicum grass	--	1000	"			
Lot B - Average weight on green Sudan grass	--	1006	"			
Average weight, all cows on green Panicum grass	-	970	"			
Average weight, all cows on green Sudan grass	-	973	"			
Difference in weight in favor of green Sudan grass	-	3	"			

In both experiments the cows averaged slightly heavier on the Sudan grass but the average difference is so slight (only 7 pounds heavier for both experiments on the Sudan grass) that it probably has no significance.

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# Butter Fat Tests

Composite samples of four consecutive milkings were tested in duplicate every week with the following results:

## Butter Fat Tests in Percent

### Experiment I

Cow Number	<u>Lot A</u>			<u>Lot B</u>		
	88	109	113	104	105	111
Average test on green Panicum grass	3.45	3.50	4.13	3.35	4.15	3.80
Average test on green Sudan grass	3.25	3.80	4.15	3.85	4.33	3.60
Lot A - Average test on green Panicum grass	--	3.69	percent			
Lot A - Average test on green Sudan grass	--	3.73	"			
Lot B - Average test on green Panicum grass	--	3.77	"			
Lot B - Average test on green Sudan grass	--	3.93	"			
Average test, all cows on green Panicum grass	-	3.73	"			
Average test, all cows on green Sudan grass	-	3.83	"			
Difference in butter fat in favor of Sudan grass		.10	"			

### Experiment II

Cow Number	<u>Lot A</u>			<u>Lot B</u>		
	52	71	96	74	79	89
Average test on green Panicum grass	3.63	3.91	4.96	4.07	4.10	5.67
Average test on green Sudan grass	3.73	4.03	4.87	3.95	4.20	5.65
Lot A - Average test on green Panicum grass	--	4.17	percent			
Lot A - Average test on green Sudan grass	--	4.21	"			
Lot B - Average test on green Panicum grass	--	4.61	"			
Lot B - Average test on green Sudan grass	--	4.60	"			
Average test, all cows on green Panicum grass	-	4.39	"			
Average test, all cows on green Sudan grass	-	4.40	"			
Difference in butter fat in favor of Sudan grass		.01	"			

While the average test for both experiments is slightly higher on Sudan grass, the average difference (.06 percent) is so slight as to have no significance.

1. The first part of the paper is devoted to a general discussion of the problem.

2. In the second part, we shall consider the case of a single particle.

3. The third part is devoted to the case of a system of particles.

4. In the fourth part, we shall consider the case of a system of particles in a magnetic field.

5. The fifth part is devoted to the case of a system of particles in a magnetic field.

6. In the sixth part, we shall consider the case of a system of particles in a magnetic field.

7. The seventh part is devoted to the case of a system of particles in a magnetic field.

8. In the eighth part, we shall consider the case of a system of particles in a magnetic field.



# Milk Production, Quantity of Feeds Fed and Feed Costs

The following condensed table gives the most important data concerning average milk production, quantity of feeds consumed, costs, etc.

	Experiment I		Experiment II		Average of Expts. I & II	
	Cows on 'Panicum 'grass	Cows on 'Sudan 'grass	Cows on 'Panicum 'grass	Cows on 'Sudan 'grass	Cows on 'Panicum 'grass	Cows on 'Sudan 'grass
Average pounds milk produced per cow per day	18.57	20.43	22.05	24.05	20.31	22.24
Average pounds concentrates <sup>(1)</sup> fed per cow per day	12.07	12.00	14.62	14.62	13.34	13.31
Concentrate feed costs per 100 lbs. of milk produced	\$0.79	\$0.71	\$0.94 <sup>(2)</sup>	\$0.86 <sup>(2)</sup>	\$0.86	\$0.78
Pounds milk produced per pound concentrates fed	1.54	1.70	1.51	1.64	1.52	1.67
Average pounds roughage consumed per cow per day	41.9	48.1	57.2	64.4	49.5	56.2
Roughage cost per 100 pounds of milk <sup>(3)</sup>	\$0.68	\$0.71	\$0.78	\$0.80	\$0.73	\$0.75
Total feed cost per 100 pounds of milk	\$1.47	\$1.42	\$1.72	\$1.66	\$1.59	\$1.54

The preceding table shows that with the same quantity of concentrates the cows averaged about nine percent more milk when fed the Sudan grass. This was true not only of the average but of every individual cow in both experiments as is shown in the following tables.

<sup>(1)</sup> Beet pulp was included as a concentrate in these experiments.

<sup>(2)</sup> Feed prices were higher during the time of Experiment II.

<sup>(3)</sup> Both roughages were assumed to cost \$6.00 per ton (green basis).





Average Daily Milk Production in Pounds

Experiment I

Cow Number	<u>88</u>	<u>104</u>	<u>105</u>	<u>109</u>	<u>111</u>	<u>113</u>
On Panicum grass	22.17	19.14	21.00	17.75	18.79	12.53
On Sudan grass	24.57	19.82	21.43	20.29	19.89	16.50

Experiment II

Cow Number	<u>52</u>	<u>71</u>	<u>74</u>	<u>79</u>	<u>89</u>	<u>96</u>
On Panicum grass	21.86	20.62	23.57	24.19	20.81	21.24
On Sudan grass	24.52	24.52	25.40	24.45	21.81	23.71

More Sudan Grass Consumed

In both experiments the cows with an unlimited supply of each roughage available consumed more of the Sudan grass, averaging thirteen percent more for the two experiments. This would indicate a slightly higher value, pound for pound, for the Panicum grass, for with practically the same quantity of concentrates fed in each case it required 2.44 pounds of Panicum grass to produce a pound of milk and 2.53 pounds of Sudan grass.

The Panicum grass used, especially in the second experiment, was of excellent quality with practically none of the dry coarse stems often found in this grass when the fields are allowed to become too mature before cutting. It is possible that in pasturing Panicum grass, where cattle continuously feed on only the young tender shoots, the consumption of Panicum grass might be much higher than in these experiments.

Summary and Conclusions

1. In two experiments in which green Panicum grass was compared with green Sudan grass as roughages for dairy cows (both used as soiling crops) no significant difference resulted in either the weight of the cows or the butter fat content of their milk.

2. Milk production was about nine percent higher when the Sudan grass was fed. However, it must be added that Sudan grass when the roughages were used as soiling crops, as they were in this case, proved more palatable, the cows consuming an average of 56.2 pounds green Sudan per day as compared with only 49.5 pounds of the green Panicum grass.

Experiment 1: Effect of Lactation on Food Intake

Experiment 1

Cow Number	88	104	106	108	110	112
On Lactation	22.12	19.14	21.00	18.76	18.76	18.76
On Ration	24.27	19.72	21.43	20.29	19.27	18.76

Experiment 2

Cow Number	88	104	106	108	110	112
On Lactation	21.86	20.82	22.57	21.19	20.81	21.14
On Ration	24.27	24.12	25.15	24.15	21.71	24.71

Notes on Food Intake

In both experiments the cows were on unlimited supply of food. The food available consisted of the ration plus whatever was left over from the previous day. The food intake was recorded for the two experiments. The food intake was slightly higher for the cows on the ration than for the cows on lactation. The same quantity of food was given to each cow. It required 2.44 pounds of ration to produce a pound of milk and 2.55 pounds of ration to produce a pound of milk.

The ration was used, especially in the second experiment, was of excellent quality with practically none of the dry cows being able to eat it. In this experiment the food was allowed to become stale before being eaten. It is possible that in the second experiment the cows were able to eat only the very best of the food. The composition of the ration was much higher than in the first experiment.

Summary and Conclusions

1. In the experiments in which the ration was used as food, the cows on lactation ate less food than the cows on the ration. The cows on the ration ate more food than the cows on lactation. The cows on the ration ate more food than the cows on lactation.

2. The ration was used as food in the second experiment. The cows on lactation ate less food than the cows on the ration. The cows on the ration ate more food than the cows on lactation. The cows on the ration ate more food than the cows on lactation.



3. When comparisons are based on the actual quantity of roughages consumed, Sudan grass was worth, pound for pound, only 96 percent as much as the Panicum grass. However, because of the greater palatability and consumption of the former, Sudan grass resulted in higher milk production.

4. Based on the results of these two experiments, it seems that if both green feeds are available in unlimited quantities, Sudan grass will give the better milk yields and should be used. However, the relative yields per acre and growing costs of these two roughages, which were not covered in the present experiments, become major considerations in this problem.

3. With consideration of the fact that the quantity of the sugar consumed, Cuban sugar was worth, about 100,000 tons, only 25 percent as much as the foreign sugar. However, because of the greater relative bill of the consumption of the foreign, Cuban sugar received a higher price.

4. Based on the results of these two experiments, it seems that if both sugar yields and available in sufficient quantities, Cuban sugar will give the better price. This is especially so when the relative yields per acre and the relative costs of these two countries which were not covered in the present experiments, become a factor in the calculation in this problem.